

Labor Market Implications of Switching the Currency Peg in a General Equilibrium Model for Lithuania

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Abstract

On February 2, 2002, Lithuania switched its currency anchor from the dollar to the euro. While pegging to the dollar (since April 1994) has proven successful throughout the transition years, the recent decision to peg to the euro was motivated by the increasing trade relations with European economies. Pizzati does not argue which peg is more appropriate, but he analyzes the implications of changing the exchange rate regime for different sectors and labor groups.

While pegging to the euro entails more stability for the export sector, Lithuania is still dependent on dollar-based imports of primary goods from the Commonwealth of Independent States, more so than other Baltic countries or Central European economies.

Pizzati uses a multisector general equilibrium model to compare the effects of dollar-euro exchange rate movements under these alternative pegs. Overall, simulation results suggest that while a euro-peg will provide more stability to GDP and employment, it will also imply more volatility in prices, suggesting that under the new peg macroeconomic policy should be more concerned with inflationary pressures than before. From a sector-specific perspective, pegging to the euro will provide a more stable demand for unskilled-intensive manufacturing and commercial services. But other sectors, such as agriculture, will still face the same vulnerability to exchange rate movements. This suggests that additional policy measures may be needed to compensate sector-specific divergences.

This paper—a product of the Poverty Reduction and Economic Management Sector Unit, Europe and Central Asia Region—is part of a larger effort in the region to address European Union integration issues in transition economies. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Lodovico Pizzati, room H4-214, telephone 202-473-2259, fax 202-614-0683, email address lpizzati@worldbank.org, April 2002. (24 pages)

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* The findings, interpretations, and conclusions are the author's own and should not be attributed to the World Bank. The author may be contacted at: lpizzati@worldbank.org .

INTRODUCTION

After more than seven years of pegging the litas (the Lithuanian currency) to the dollar, on February 2nd, 2002 Lithuania's Currency Board switched to the euro as the new anchor. The currency peg to the dollar had successfully provided the necessary stability for a small open economy in transition. Fixing the exchange-rate to an appreciating currency helped stabilize inflation and yet still attained export-led growth. While the stabilizing effects on prices are expected of a currency board arrangement, Lithuania also achieved an adequate growth path. This is partly because the domestic currency was initially fixed at an undervalued parity, making Lithuanian products very competitive in the world market. The resulting expansionary effect diminished only gradually as the real exchange-rate was appreciating.

The decision to switch the currency peg from the dollar to the euro is essentially based on two considerations. First, it is a reflection of the shift in composition of Lithuanian trade. While a decade back Lithuania was still very dependent on dollar-based trade flows with CIS economies, Lithuania has gradually become more interdependent with the European Union (see Figures 1a and 1b). Second, as EU accession is one of the main objectives in the country's agenda, the eventual adoption of the EU tariff's schedule for extra-European trade, and the elimination of agricultural quotas for intra-European trade, will further integrate Lithuania in the European markets. Given these considerations, Lithuania is better off pegging the litas to the currency of its main trading partners.

Although the switch in currency peg per se will not have an impact on the real economy, distinct sectors of the economy will now be affected differently from dollar-euro exchange-rate movements. In particular, what will be the consequences for the labor market? Are there some implications for unemployment of switching the currency peg, if labor groups are affected differently? While Lithuania has achieved low inflation, stable growth and controlled fiscal and current account deficits, it has a double digit unemployment rate. Will employment benefit from the change in exchange rate policy? How can government policies complement the effects of euro-peg and EU accession and make the most of labor market movements to reduce unemployment?

Figure 1a. Share of Total Exports by Trade Area

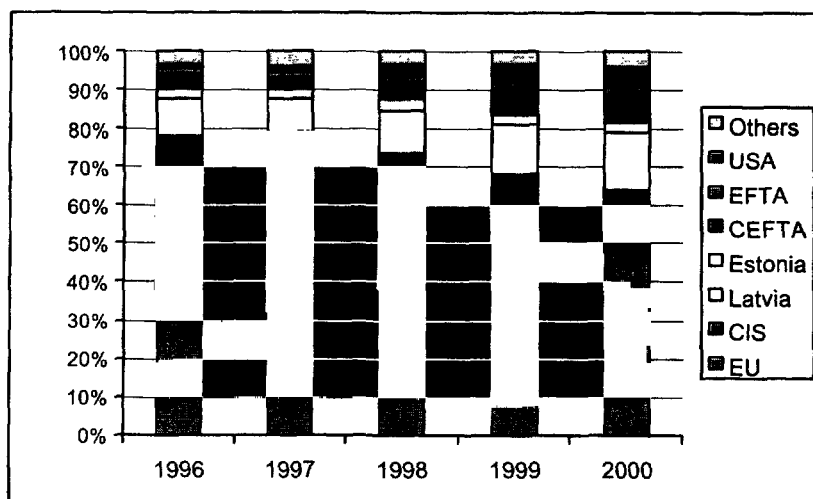
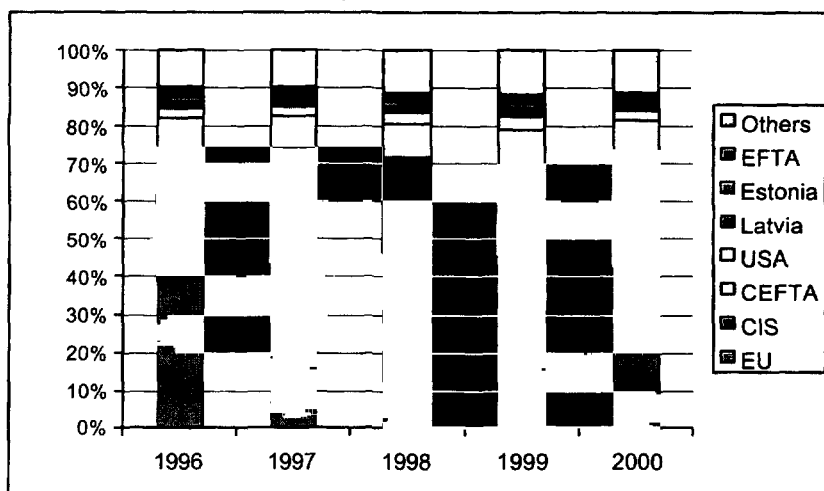


Figure 1b. Share of Total Imports by Trade Area



CEFTA: Bulgaria (1999), Czech Republic, Hungary, Slovakia, Slovenia, Poland, Romania (1997).

EFTA: Iceland, Liechtenstein, Norway, Switzerland.

Source: Lithuanian Department of Statistics.

This chapter uses a Computable General Equilibrium (CGE) model to provide a quantitative assessment of the outcome of change in currency peg and of EU accession. In order to capture the effect of exchange-rate movements under different pegs, this model introduces a dual set of trade flows. By distinguishing between dollar-based and euro-based trade, it is possible to analyze the effects on a small-open economy that is still largely dependent on dollar-based primary imports from CIS economies, but whose

growth relies on exports to Europe. Furthermore, this paper considers the dynamics of different labor groups which may be affected in dissimilar ways by trade policy. In particular, for a country that imports high-skilled intensive goods and exports low-skilled intensive goods, a change in peg may alter the effects of trade on the labor market (see Figures 2a and 2b).

Figure 9a. Exports by Combined Nomenclature (CN) Sectors

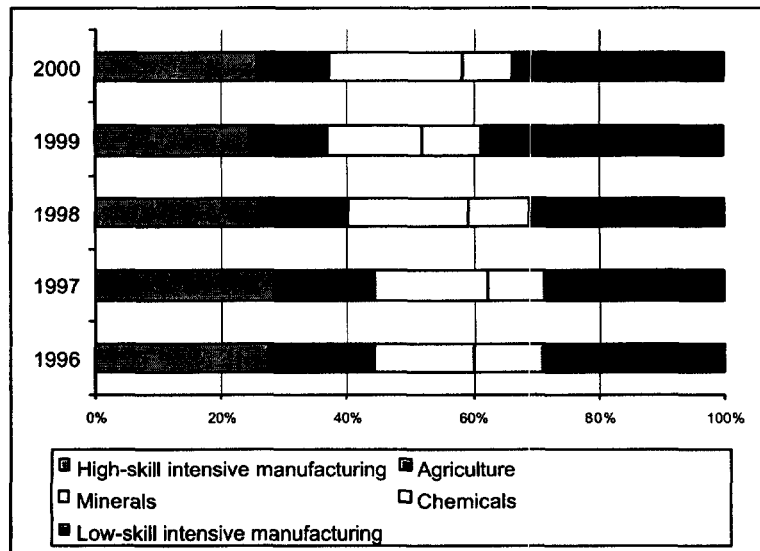
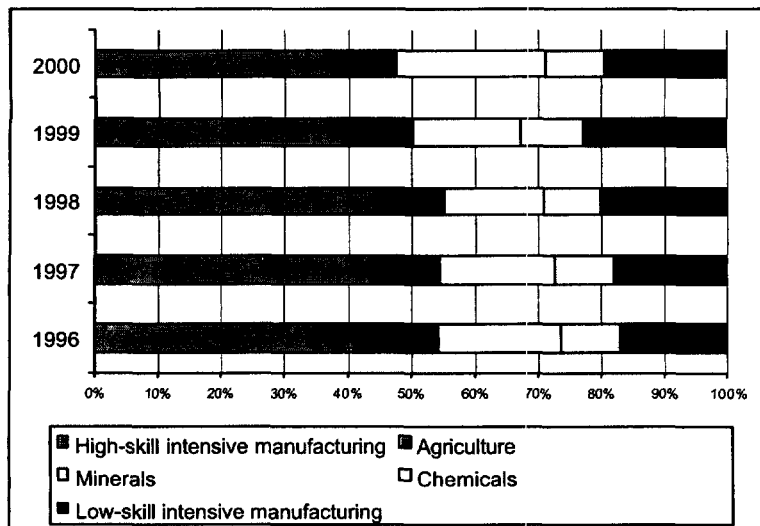


Figure 9b. Imports by Combined Nomenclature (CN) Sectors



Source: Lithuanian Department of Statistics

Simulation results from this CGE model suggest that indeed the choice of currency peg will affect the influence of exchange-rate movements on the economy. In general, pegging to the euro provides more stability for GDP, unemployment and the trade deficit. On the other hand, a euro-peg appears to increase, although moderately, the sensitivity of inflation to exchange rate fluctuations. Therefore, while a euro-peg will provide more stability for growth, policymakers should also prepare for more inflation pressures than under a dollar-peg. The impact on individual exporting sectors and the labor market suggests that service and labor intensive manufacturing will face less volatility under a euro-peg. On the other hand, agriculture and capital-intensive manufacturing will face more volatility under a euro-peg than they did under the dollar-peg.

A CGE MODEL WITH LABOR GROUPS AND DUAL TRADE

The advantage of analyzing the change in currency-peg with a general equilibrium model is that it captures not only the effects of trade flows on production and labor demand, but it also internalizes the effects that policies and external shocks have on income, and subsequently on aggregate demand and prices. In particular, the benefits of general equilibrium analysis apply when studying diverse responses of production sectors and labor groups. In fact, this study disaggregates production by main economic activities (agriculture, manufacturing, services, public sector), and it further distinguishes the energy sector and oil refineries, whose production highly depends on dollar-based primary inputs. In addition, the labor force is divided between skilled and unskilled workers in order to capture the distinctive effects that the policy issues in question have on these labor groups. This model provides a quantitative assessment to help understand the dynamics between sectors and labor groups in a trade-oriented economy like Lithuania.

Modeling trade areas

Even among Baltic countries, Lithuania was the economy most dependent on Russian trade flows (which justified the initial dollar-peg). Its transition to being an export-led economy makes it now more dependent for economic growth on European markets. In this model, trade flows are treated separately (by dollar and euro area) in order to capture how distinct sectors and labor groups will be affected by exchange-rate fluctuations under different currency pegs. Therefore, the trade account (deficit) is defined as follows:

$$(1) TRDEF = R^{US} \cdot (pwe^{US} \cdot E^{US} - pwm^{US} \cdot M^{US}) + R^{EU} \cdot (pwe^{EU} \cdot E^{EU} - pwm^{EU} \cdot M^{EU})$$

The trade account is expressed in domestic currency. Therefore, quantities of exports and imports from the dollar and euro trade area (E^{US} , M^{US} and E^{EU} , M^{EU} respectively) are expressed in foreign prices times the respective exchange rates. Foreign prices in the dollar and euro area (pwe^{US} , pwm^{US} and pwe^{EU} , pwm^{EU} respectively) may or may not be equal, but are taken exogenously by the Lithuanian market. Overall, the trade deficit is still defined in litas as exports minus imports, but with the disaggregated description of Equation (1) it is possible to analyze the effects of different currency board regimes. In a dollar peg, the litas-dollar exchange rate, R^{US} , is held fixed, and exogenous exchange-rate fluctuations are described by a changing litas-euro exchange rate, R^{EU} . The opposite applies under a euro-peg.

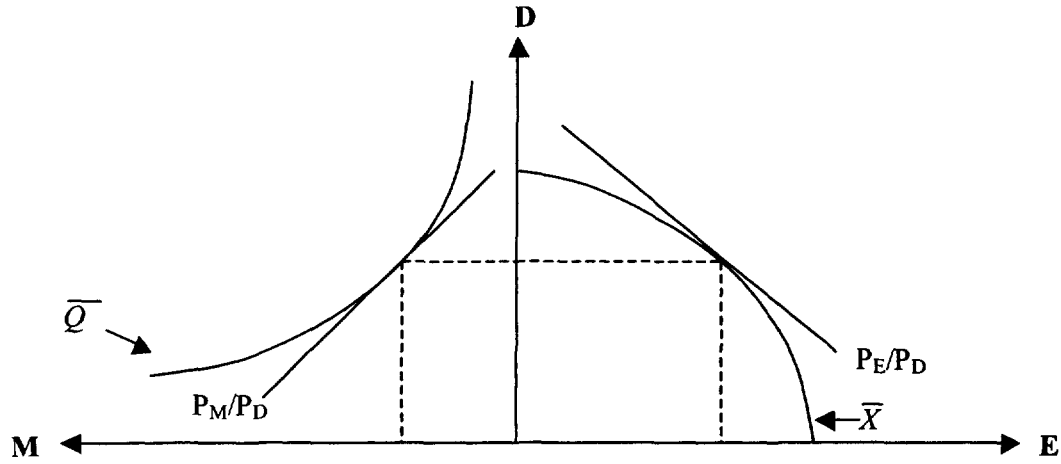
Import demand of foreign products and export supply of Lithuanian products depend on the relative prices of traded goods compared to the domestically produced goods. As in traditional CGE models, aggregate domestic production is channeled to exports or to the domestic market, while aggregate domestic demand is comprised of domestic goods and imports:

$$(2) \quad X = CET(E, D; \sigma^T)$$

$$(3) \quad Q = CES(M, D; \sigma^Q)$$

Equation (2) describes how for a give level of production, X , there is a production possibility frontier of exports, E , and domestic-market goods, D . Figure 3 illustrates how the combination of exports and domestic goods depends on relative prices, and the elasticity of transforming from exports to the domestic market, s^T . Similarly, Equation (3) describes how for a given level of aggregate demand, Q , there is an isoquant of imports, M , and domestically-produced goods, D . Again, Figure 3 shows how the actual levels depend on relative prices and the elasticity of substituting from imports to domestic goods, s^Q .¹

Figure 3. Imports, Exports and Domestic Goods



Aggregate production is supplied by firms to domestic and foreign markets in shares that maximize sales. Accordingly, export supply increases as export price increases, and is derived as:²

$$(4) \quad E/D = f\left(\frac{P_E}{P_D}; \sigma^T\right)$$

¹ The complete form of Equations (2) and (3) are expressed in the Appendix Equations (A8) and (A12). See Devarajan et al. (1997) .

² See Appendix Equation (A9) for explicit form.

Similarly, aggregate demand is composed of imports and domestic goods in shares that minimize total expenditures. Accordingly, import demand will decrease as import prices increase, and is derived as:³

$$(5) \quad M/D = f\left(\frac{P_D}{P_M}; \sigma^D\right)$$

While the above modeling of trade behavior is consistent with the trade CGE literature,⁴ this paper further disaggregates imports and exports by trade area. This model expansion is necessary to capture the effects of a switch in currency peg.⁵ Therefore, imports and exports are split according to dollar-based and euro-based trade, and the share of trade allocated to each group depends on relative prices of these traded goods:

$$(6) \quad E = CET(E^{US}, E^{EU}; \sigma^E)$$

$$(8) \quad E^{US}/E^{EU} = f\left(\frac{P_E^{US}}{P_E^{EU}}; \sigma^E\right)$$

$$(7) \quad M = CES(M^{US}, M^{EU}; \sigma^M)$$

$$(9) \quad M^{US}/M^{EU} = f\left(\frac{P_M^{EU}}{P_M^{US}}; \sigma^M\right)$$

The effect of trade policy or the influence of exogenous dollar-euro exchange-rate fluctuations under different pegs will affect domestic prices of traded goods:

$$(10) \quad P_E^{US} = pwe^{US} \cdot (1 + te^{US}) \cdot R^{US}$$

$$(12) \quad P_M^{US} = pwm^{US} \cdot (1 + tm^{US}) \cdot R^{US}$$

$$(11) \quad P_E^{EU} = pwe^{EU} \cdot (1 + te^{EU}) \cdot R^{EU}$$

$$(13) \quad P_M^{EU} = pwm^{EU} \cdot (1 + tm^{EU}) \cdot R^{EU}$$

Equations (10)-(13) describe how the domestic price of traded goods are determined by the world price of these goods (pwe and pwm), plus the effects of trade policy (import tariffs, tm , and export subsidies, te , if any) and exchange rate fluctuations.

³ See Appendix Equation (A13) for explicit form. As with exports, imports are not perfectly substitutable with the domestic goods. Therefore, although import prices may increase, demand for domestic goods will change depending on the elasticity of substitution (σ^D) between these goods.

⁴ See Devarajan et al. (1994), Robinson (1999)

⁵ Tesche (1995) CGE for Hungary also divides trade (between dollars and rubles trade area). However, her simulation keeps ruble trade exogenous, reflecting the lack of market dynamics in the 1970s.

For example, under a euro-peg, the litas-euro exchange rate (R^{EU}) is fixed, and a dollar depreciation would be captured by an increase in R^{US} (and a decrease in the event of an appreciation). The opposite would be true under a dollar-peg. Clearly, under this system of equations the change in tariffs coming from EU accession will alter the domestic prices of traded goods, and consequently the share of trade levels.

On the other hand, exchange-rate fluctuations under different currency pegs would not produce different results for a sector which trades in both the dollar-area and the euro-area. Under both cases, relative prices would be affected in the same fashion, with identical implications for trade. However, some sectors like energy and oil refineries predominantly import dollar-based primary goods, and a dollar appreciation (depreciation) could not be offset by substituting into euro-based imports. In this case, the choice of currency peg will affect the economy, since these sectors produce important intermediate goods for other sectors.⁶

Modeling labor groups

As shown in Figures 9a and 9b of Chapter 1, Lithuania is mainly an exporter of low-skill intensive goods and mostly an importer of high-skill intensive goods. This diversity between imports and exports suggest that trade policy or external shocks, which will alter trade patterns, may have an effect on the labor market. Understanding the dynamics between trade and the labor market is of particular importance for policymakers. With concerns such as high unemployment and an agricultural sector in need of restructuring, this will provide an insight on what policies may best complement EU accession and the change in currency peg.

Each sector is assumed to employ both skilled and unskilled workers, and labor demand for each of these groups is determined by the firms' production needs. However, these labor groups are assumed to have different utility in the production process. For example, skilled workers are assumed to complement the employment of capital in production. Conversely, employing low-skilled workers is considered a substitute input to

⁶ Another sector that would be affected similarly is agriculture, which, although it predominantly produces for the domestic market, its principal export target are other CIS economies.

skilled workers or capital.⁷ This relationship rests on the assumption that skilled workers are defined as being part of capital intensive production, while low skilled workers represent the alternative of labor intensive production. Therefore, the production function in each sector is modeled as:

$$(14) \quad X = Leontief(V, N)$$

$$(15) \quad V = CES(L^U, T; \sigma^V) \quad \text{and where} \quad T = CES(L^S, K; \sigma^C)$$

Equation (14) describes output, X , as being a *Leontief* function of intermediate inputs, N , and the value-added in production, V . Intermediate inputs are products of other sector used as inputs in this specific sector, while a *Leontief* function simply signifies that in order to reach a level of production intermediate inputs and value-added are used in fixed proportions with no substitutability. Equation (15) expresses value-added production as a function of unskilled workers (L^U) and a composite input (T) of skilled workers (L^S) and capital (K). It should be noted that the elasticity of substitution between skilled workers and capital (σ^C) is low (signifying complementarity), while the elasticity of substitution between these two inputs and unskilled workers (σ^V) is high (indicating substitutability).

This explicit modeling of the production process and of the corresponding labor demand functions (see Appendix) permits an analysis of several economic interactions. First, an increase in production is positively related to an increase in labor demand, and an increase in labor costs (wages) will affect production prices. Second, a change in prices of key intermediate inputs (such as energy and oil refineries products) will affect costs of production, with consequences for the labor market and the aggregate price level. For instance, if a capital intensive sector is heavily dependent on intermediate demand for energy, demand for skilled workers will be particularly affected from external shocks to the energy sector. Third, an influx of foreign direct investment (which is in itself affected by exchange-rate movements) will increase the stock of capital and shift labor demand from low-skilled to high-skilled workers with implications for low-skilled unemployment. Fourth, modeling separately low-skilled and high-skilled intensive

⁷ See Fargeix and Sadoulet (1994) for similar approach of labor market.

manufacturing sectors adds more labor market dynamics originating from trade-related shocks.

In the labor market for low-skilled workers, wages are assumed to be set at the minimum wage level, and it is the employment level that varies. Also, it is assumed that there is labor movement between sectors so that a drop in employment in one sector could be partly compensated by increases in other sectors and not necessarily have a direct impact on the unemployment rate. The time frame in which trade policy and external shocks are analyzed is approximately three to four years, so that there is enough time for the labor market to clear within a labor group. Skills acquisition are not modeled in this framework, so that an increase in demand of skilled-workers is not fulfilled by “new” skilled workers coming from the unskilled workforce. This model did not attempt to approximate a skills acquisition function, however, an increase in demand for high-skilled labor should be interpreted as creating incentives for skills acquisition.

The public sector and the currency board

Equations (10)-(13) introduced the role of government with import tariffs and export subsidies (if any). Other sources of tax revenues incorporated in this framework are the income tax (excised from labor’s and firms’ income) and a sales tax applied to the sale of domestic goods. Other components of the primary deficit (or surplus) are government spending and the profits (or losses) from public enterprises. The overall deficit (composed of primary deficit plus interest payments on government debt) are financed either by new public borrowing or by domestic credit from the central bank.⁸

In this framework, the domestic banking sector, as a source of financing for private firms and for government deficit is not explicitly modeled, leaving foreign borrowing as the main source of financing (both for government deficits and private investment). The central bank’s balance sheet is also simplified. It includes domestic credit to the government and foreign reserves as its assets, and stock of money, growing at an exogenous level, as liabilities. In a currency board regime, a central bank cannot conduct an active monetary policy since the money supply (a liability) is supposed to compensate any changes in foreign reserves (an asset) necessary to keep the exchange

⁸ See Appendix equation (A50) for explicit definition of deficit financing.

rate even. Table 16 of Chapter 1, shows how in order to defend the exchange rate parity during the Russian financial crisis, foreign reserves dropped by 15%. However, the corresponding drop in liabilities was mostly taken by central government deposits (which took two thirds of the drop). The drop in currency and commercial banks deposits compensated for less than a third of the drop in central bank's assets, most likely in line with a decrease in economic activity. Therefore this model has domestic credit to the government as the variable clearing the changes in the central bank's balance sheet.

Finally, the level of foreign reserves varies to offset any balance of payments fluctuations that may affect the exchange-rate parity. The central bank holds foreign reserves of euros and dollars. Under an euro-peg, the Bank of Lithuania varies the reserve of euros, while for simulation comparisons, the dollar-peg will be characterized by having the reserves of dollars clearing the balance of payments. However, this is not the crucial assumption that drives the simulation results comparing a euro-peg and a dollar-peg (that rests on the effects of trade). The balance of payments is composed by the trade account (discussed in Equation (1)) and the financial account, which includes foreign loans to the government and to the private sector.⁹

EXCHANGE-RATE MOVEMENTS UNDER ALTERNATIVE PEGS

This section explores the effects of dollar-euro exchange-rate movements on the Lithuanian economy. Will it matter which currency the litas is pegged to? As suggested in the previous section, sectors that trade in both areas will be affected in the same fashion under either currency peg. For example, a dollar appreciation under a euro-peg will shift exports to the dollar trade-area, as Lithuanian exports become cheaper in dollar terms. The same appreciation under a dollar-peg will shift exports away from the euro trade-area, since Lithuanian exports become more expensive in euro terms. The effects in these sectors would be identical. However, for sectors that only import in dollar terms (the case of primary inputs) or that only export to Europe, the choice of currency peg will matter. This is because these sectors cannot shift their trade flows from one trade area to

⁹ See Appendix Equation (A52) for explicit form.

another. This section studies how the impact on these sectors will affect other sectors and the workers they employ.

Effects on Main Macroeconomic Indicators

Figure 4 depicts how aggregate prices, output and deficit are affected by either an appreciation or depreciation of the dollar vis-à-vis the euro. The results are based on simulations under either a euro-peg or a dollar-peg. First, it should be noted how a dollar appreciation has an opposite effect depending on which peg regime is being considered. Obviously, if pegged to an appreciating currency, the litas will appreciate with it, while if pegged to a depreciating currency, the litas will depreciate with it as well. This explains how the same 3% dollar appreciation has opposite effects depending on whether the Lithuanian currency board is pegged to the dollar or to the euro. However, as it is shown in Figure 4, the magnitudes are not at all symmetric. For instance, the effects of exchange-rate fluctuations on GDP are much more volatile under a dollar-peg than under a euro-peg. Why is this so?

Since the Lithuanian economy is heavily dependent on exports, it is no surprise that pegging to the currency of its main trading partners results in less GDP volatility from exchange-rate variation. In fact, the effects on the trade deficit are similar and even more pronounced. Under a dollar peg, an appreciating dollar would slow down exports to European markets, widening the gap between import and exports. Of course, not all sectors depend on European economies, but Figure 4 suggests that the majority of trade-oriented sectors do rely on euro-based trade. On the other hand, those sectors that are tied to dollar trade (such as oil refineries, energy and part of manufacturing imports) appear to have a certain weight on the price level. In fact, although an euro-peg significantly reduces GDP volatility, under this new currency regime the price level will be slightly more responsive to exchange-rate fluctuations. Although the discrepancy is not as striking as with GDP or the trade deficit, the effects on prices of some dollar-dependent sectors should not be overlooked.

The litas peg to the euro should also provide less volatility for government finances. As this model assumes that government revenues rely on income and sales taxes, it is not surprising that the fiscal budget is affected similarly to the GDP. On the

other hand, tariff revenues from dollar-based imports should be more volatile under a euro-peg.¹⁰ Finally, it is interesting to notice how the effects on unemployment of low-skilled workers closely follows the dynamics of the trade deficit. Why is the unemployment level much less volatile under a euro-peg (as shown in Figure 4)? To understand the dynamics between trade and the labor market, it is necessary to look at sector-level findings.

Effects on exporting sectors

Figure 5 shows how individual sectors are affected by exchange-rate movements under alternative currency pegs. Not surprisingly, each sector is negatively affected by a dollar appreciation under a dollar-peg, and positively affected by the same dollar appreciation under a euro-peg. This is clearly because in the dollar-peg scenario Lithuanian products would be more expensive in world markets, and under a euro-peg they would be cheaper. Despite this similarity across sectors, the magnitude of this effect is not only different under each currency peg, but it differs in direction from sector to sector.

First, the most straight forward occurrence is the case of commercial services and unskilled-intensive manufacturing. Both of these sectors predominantly export to European markets, therefore pegging to the currency of the major trading partners (the euro) will reduce export fluctuations from exchange-rate movements. Second, the agriculture and energy sectors are affected in the opposite way. These are sectors that mainly produce for the domestic market, but the export they engage in is to either other Baltic countries or to CIS economies. Therefore, if the litas is pegged to the euro, their export will not benefit of the same exchange-rate stability that other Europe-oriented sectors will enjoy. This explain how the agriculture and energy may face a more volatile international trade scenario under a euro-peg. Third, the effect on oil refineries differ from all other sectors. Their production only depends on dollar-based imports of crude oil. Therefore while a dollar appreciation will slow down exports under a dollar-peg, under a euro-peg, crude oil imports will cost more and hence reduce production (and

¹⁰ This result rests on the modeling assumption that government spending is an exogenous policy variable. This section does not discusses how active fiscal policy in response to exchange-rate fluctuations may affect the fiscal budget.

consequently exports). Fourth, the effect on exports of skill-intensive manufacturing shows how a euro-peg will present more volatility. Since Lithuania is a primary importer of skill-intensive goods, it explains why this sector's export responds differently. Under a euro-peg dollar-based imports will be more expensive when the dollar appreciates. This shifts demand toward the domestically produced skill-intensive good. The increased production will have a direct effect on exports, besides having implications for labor demand of skilled workers.

Effects on the labor market

Figure 6 exposes the parallel effects between exports and labor demand. The employment level of unskilled workers in the services and the labor-intensive industry is less volatile under a euro-peg. This result is clearly consistent with the fact that Lithuania is a primary exporter of labor-intensive goods (mostly to Europe) and that exports will be less volatile under a euro-peg (since it will have no exchange-rate fluctuations with the primary trading partners). On the other hand, agriculture will not benefit from the litas peg to the euro, since it will still face the similar levels of employment volatility, though the direction will be opposite.

The last graph in Figure 6, shows the effects of exchange-rate movements on wages for skilled workers. The reason why skilled-workers' wages fall with a dollar appreciation under a dollar-peg is because of decreased labor demand. Interestingly, a euro-peg will provide less volatility for the skilled-labor market, which is in contrast with the increased variation of unskilled-labor demand in the capital-intensive market. This suggests that under a euro-peg there will be more stability in foreign direct investment flows, which will stabilize capital-intensive production. Skilled workers, being a complementary input of capital, will face the same stability in their labor demand, while unskilled workers, being a substitute in production, will face more variability in these capital-intensive sectors.

Overall, the implication of euro-peg for the labor market is the following. Skilled workers will face a more stable labor demand, with respect to exchange-rate fluctuations. The unemployment rate for unskilled workers will also be much less sensitive to exchange-rate movements (see Figure 4), however this is mostly a reflection of labor-

intensive industry (and services) which exports primarily to European markets. The agricultural sector, on the other hand will still face the same vulnerability to exchange-rate movements, as employment in this sector will not be subject to less volatility under the euro-peg.

CONCLUSION

Lithuania's decision to change its currency peg from the dollar to the euro is based on the increasing trade flows with the European Union and as a step of further integration with the EU. This paper does not question the overall benefits of pegging to the euro, but instead it examines how distinct sectors and labor groups may be affected in different ways. Although, merely switching the peg will not have an impact per se, this chapter explains how different currency anchors may actually affect the magnitude of external shocks on the economy. The research findings are based on explicitly modeling trade to the European Union and to the rest of the World, and on differentiating between skilled and unskilled workers.

Understanding the impact of world exchange-rate movements is crucial for policymaking in a small open-economy. This paper provides a disaggregate approach to the dynamics that channel the effects of the exchange-rate on different sectors of the economy and labor groups.

This study finds that pegging to the currency of the main trading partners will indeed stabilize output, employment and the trade deficit, but it will also bring more volatility to inflation, since production is still heavily reliant on dollar-based inputs. The policy implications are that under the new currency peg, price stability may become a more relevant policy issue than in the past. More importantly, government policy should focus on sectors, like agriculture, which will not face lower output and employment stability under the new currency peg.

APPENDIX

Below is the full specification of the equations used in this CGE model, followed by definitions of endogenous variables, exogenous variables and parameters. Simulation results were computed using the Newton's solution algorithm available in the Eviews 4.0 econometric software. The Newton's method consists of repeatedly solving a local linear approximation of the system of equations. The subscript i is used to index the pertinent equations by sectors (agriculture, skilled-intensive manufacturing, unskilled-intensive manufacturing, commercial services, public services, energy, oil refineries and primary inputs – when applicable). Computations and parameters' calibration are based on data provided by the Bank of Lithuania and the Lithuanian Statistical Office. The simulation program and the data used are available upon request to the author.

Equations

Production

$$(A1) \quad X_i = V_i / \gamma_i$$

$$(A2) \quad V_i = \alpha_i^\nu \cdot \left\{ \beta_i^\nu \cdot (L_i^U)^{-\rho_i^\nu} + (1 - \beta_i^\nu) \cdot (T_i)^{-\rho_i^\nu} \right\}^{\frac{1}{\rho_i^\nu}}$$

$$(A3) \quad T_i = \alpha_i^c \cdot \left\{ \beta_i^c \cdot (\bar{L}_i^S)^{-\rho_i^c} + (1 - \beta_i^c) \cdot (K_i)^{-\rho_i^c} \right\}^{\frac{1}{\rho_i^c}}$$

$$(A4) \quad K_i = K_{i-1} + \phi_i \cdot \frac{Z_i}{PQ_i}$$

Labor

$$(A5) \quad L_i^U = V_i \cdot \left(\beta_i^\nu \cdot (\alpha_i^\nu)^{-\rho_i^\nu} \cdot \frac{PV_i}{\bar{W}_i^U} \right)^{\frac{1}{1+\rho_i^\nu}}$$

$$(A6) \quad W_i^S = PT_i \cdot \beta_i^c \cdot (\alpha_i^c)^{-\rho_i^c} \cdot \left(\frac{T_i}{\bar{L}_i^S} \right)^{1+\rho_i^c}$$

$$(A7) \quad U^U = L^U - \sum_i L_i^U$$

Trade

$$(A8) \quad X_i = \alpha_i^T \cdot \left\{ \beta_i^T \cdot E_i^{\rho_i^T} + (1 - \beta_i^T) \cdot D_i^{\rho_i^T} \right\}^{\frac{1}{\rho_i^T}}$$

$$(A9) \quad E_i = D_i \cdot \left(\frac{PE_i}{PD_i} \cdot \frac{1 - \beta_i^T}{\beta_i^T} \right)^{\frac{1}{\rho_i^T - 1}}$$

$$(A10) \quad E_i = \alpha_i^E \cdot \left\{ \beta_i^E \cdot (E_i^{US})^{\rho_i^E} + (1 - \beta_i^E) \cdot (E_i^{EU})^{\rho_i^E} \right\}^{\frac{1}{\rho_i^E}}$$

$$(A11) \quad E_i^{US} = E_i^{EU} \cdot \left(\frac{PE_i^{US}}{PD_i^{EU}} \cdot \frac{1 - \beta_i^E}{\beta_i^E} \right)^{\frac{1}{\rho_i^E - 1}}$$

$$(A12) \quad Q_i = \alpha_i^Q \cdot \left\{ \beta_i^Q \cdot (M_i)^{-\rho_i^Q} + (1 - \beta_i^Q) \cdot (D_i)^{-\rho_i^Q} \right\}^{\frac{1}{\rho_i^Q}}$$

$$(A13) \quad M_i = D_i \cdot \left(\frac{PS_i}{PM_i} \cdot \frac{\beta_i^Q}{1 - \beta_i^Q} \right)^{\frac{1}{1 + \rho_i^Q}}$$

$$(A14) \quad M_i = \alpha_i^M \cdot \left\{ \beta_i^M \cdot (M_i^{US})^{-\rho_i^M} + (1 - \beta_i^M) \cdot (M_i^{EU})^{-\rho_i^M} \right\}^{\frac{1}{\rho_i^M}}$$

$$(A15) \quad M_i^{US} = M_i^{EU} \cdot \left(\frac{PM_i^{EU}}{PM_i^{US}} \cdot \frac{\beta_i^M}{1 - \beta_i^M} \right)^{\frac{1}{1 + \rho_i^M}}$$

$$(A16) \quad Q_i = (C_i + G_i + Z_i + N_i) / PQ_i$$

$$(A17) \quad C_i = c_i \cdot C$$

$$(A18) \quad G_i = g_i \cdot G$$

$$(A19) \quad Z_i = z_i \cdot Z$$

$$(A20) \quad N_i = \sum_j a_{ij} \cdot X_j \cdot PX_j$$

Prices

$$(A21) \quad PX_i = (E_i \cdot PE_i + D_i \cdot PD_i) / X_i$$

$$(A22) \quad PE_i = (E_i^{US} \cdot PE_i^{US} + E_i^{EU} \cdot PE_i^{EU}) / E_i$$

$$(A23) \quad PE_i^{US} = pwe_i^{US} \cdot (1 + te_i^{US}) \cdot R^{US}$$

$$(A24) \quad PE_i^{EU} = pwe_i^{EU} \cdot (1 + te_i^{EU}) \cdot R^{EU}$$

$$(A25) \quad PQ_i = (M_i \cdot PM_i + D_i \cdot PS_i) / Q_i$$

$$(A26) \quad PS_i = PD_i \cdot (1 + ts_i)$$

$$(A27) \quad PM_i = (M_i^{US} \cdot PM_i^{US} + M_i^{EU} \cdot PM_i^{EU}) / M_i$$

$$(A28) \quad PM_i^{US} = pwm_i^{US} \cdot (1 + tm_i^{US}) \cdot R^{US}$$

$$(A29) \quad PM_i^{EU} = pwm_i^{EU} \cdot (1 + tm_i^{EU}) \cdot R^{EU}$$

$$(A30) \quad PV_i = \{PX_i \cdot X_i - \sum_j PQ_j \cdot a_{ij} \cdot X_i\} / V_i$$

$$(A31) \quad PT_i = (PV_i \cdot V_i - \bar{W}_i^U \cdot L_i^U) / T_i$$

$$(A32) \quad PK_i = (PT_i \cdot T_i - W_i^S \cdot \bar{L}_i^S) / K_i$$

Income

$$(A33) \quad Y^U = U^U \cdot UB + \sum_i \bar{W}_i^U \cdot L_i^U$$

$$(A34) \quad Y^S = \sum_i W_i^S \cdot \bar{L}_i^S$$

$$(A35) \quad Y^K = \sum_i (PX_i \cdot X_i - \bar{W}_i^U \cdot L_i^U - \bar{W}_i^S \cdot L_i^S) - i^P \cdot FL_{-1}^P \quad (\text{where } i \neq SPB \text{ public sector})$$

$$(A36) \quad Y = Y^U + Y^S + Y^K$$

$$(A37) \quad C^U = (1 - s^U) \cdot (1 - ty^U) \cdot Y^U$$

$$(A38) \quad C^S = (1 - s^S) \cdot (1 - ty^S) \cdot Y^S$$

$$(A39) \quad C^K = (1 - s^K) \cdot (1 - ty^K) \cdot Y^K$$

$$(A40) \quad C = C^U + C^S + C^K$$

$$(A41) \quad S^U = s^U \cdot (1 - ty^U) \cdot Y^U$$

$$(A42) \quad S^S = s^S \cdot (1 - ty^S) \cdot Y^S$$

$$(A43) \quad S^K = s^K \cdot (1 - ty^K) \cdot Y^K$$

$$(A44) \quad S = S^U + S^S + S^K$$

$$(A45) \quad Z = S + \Delta FL^P \cdot R^{EU}$$

Public Sector

$$(A46) \quad TY = ty \cdot Y$$

$$(A47) \quad TS = \sum_i ts_i \cdot PD_i \cdot D_i$$

$$(A48) \quad TM = \sum_i (pwm_i^{US} \cdot tm_i^{US} \cdot M_i^{US} + pwm_i^{EU} \cdot tm_i^{EU} \cdot M_i^{EU})$$

$$(A49) \quad TE = \sum_i (pwe_i^{US} \cdot te_i^{US} \cdot E_i^{US} + pwe_i^{EU} \cdot te_i^{EU} \cdot E_i^{EU})$$

$$(A50)$$

$$\Delta DC + \Delta FL^G \cdot R^{EU} =$$

$$= \left[\bar{G} + U^U \cdot UB + i^G \cdot FL_{-1}^G - [TY + TS + TM - TE + (PX_G \cdot X_G - \bar{W}_G^U \cdot L_G^U - \bar{W}_G^S \cdot L_G^S)] \right]$$

$$(A51) \quad \Delta \bar{M} = \Delta DC + \Delta FR^{US} \cdot R^{US} + \Delta FR^{EU} \cdot R^{EU}$$

$$(A52)$$

$$R^{US} \cdot \Delta FR^{US} + R^{EU} \cdot (\Delta FR^{EU} + \Delta FL^G + \Delta FL^P - i^G \cdot FL_{-1}^G - i^P \cdot FL_{-1}^P) =$$

$$= R^{US} \cdot \sum_i (pwe_i^{US} \cdot E_i^{US} - pwm_i^{US} \cdot M_i^{US}) + R^{EU} \cdot \sum_i (pwe_i^{EU} \cdot E_i^{EU} - pwm_i^{EU} \cdot M_i^{EU})$$

Definitions

Endogenous Variables

C	Aggregate consumption	PM_i^{US}	Import price of good i bought in dollars
C_i	Aggregate consumption of goods i	PQ_i	Aggregate sales price of goods i
C^K	Consumption of capitalist household	PS_i	Sales price of domestic goods i
C^S	Cons. of skilled-workers household	PT_i	Composite input price in sector i
C^U	Cons. of unskilled-workers household	PV_i	Value-added price in sector i
D_i	Domestic demand for domestic product	PX_i	Production price in sector i
ΔDC	Change in domestic credit to government	Q_i	Aggregate sales of goods i
ΔFL^G	Change in foreign loans to government	S	Aggregate savings
ΔFR^h	Change in foreign reserves of currency h	S^K	Savings of capitalist household
E_i	Aggregate exports of goods i	S^S	Savings of skilled-workers household
E_i^{EU}	Exports of goods i to euro trade area	S^U	Savings of unskilled-workers household
E_i^{US}	Exports of goods i to dollar trade area	T_i	Composite input in sector i
G_i	Government spending on goods i	TE	Aggregate export subsidy expenses

K_i	Stock of capital employed in sector i	TM	Aggregate import tariffs revenues
L_i^U	Unskilled labor employed in sector i	TS	Aggregate sales taxes revenues
M_i	Aggregate imports of goods i	TY	Aggregate income taxes revenues
M_i^{EU}	Imports of goods i from euro trade area	U^U	Unemployment of unskilled workers
M_i^{US}	Imports of goods i from dollar trade area	V_i	Value-added in sector i
N_i	Intermediate demand for goods i	W_i^S	Wage rate of skilled workers in sector i
PD_i	Product price of domestic goods i	X_i	Production of goods i
PE_i	Aggregate export price of goods i	Y	Aggregate income (excluding government)
PE_i^{EU}	Export price of goods i sold in euros	Y^K	Income of capitalist household
PE_i^{US}	Export price of good i sold in dollars	Y^S	Income of skilled-workers household
PK_i	Price of capital in sector i	Y^U	Income of unskilled-workers household
PM_i	Aggregate import price for goods i	Z	Aggregate investments
PM_i^{EU}	Import price of goods i bought in euros	Z_i	Investments in sector i

Exogenous Variables

$?FL^P$	Change in foreign loans to private sector	R^{EU}	Exchange rate litas-euros
$?FR^{?h}$	Change in foreign reserves of currency $?h$	R^{US}	Exchange rate litas-dollars
$?M$	Change in stock of money	s^K	Saving rate of capitalist household
FL_{-1}^G	Stock of foreign loans to government	s^S	Saving rate of skilled-workers household
FL_{-1}^P	Stock of foreign loans to private sector	s^U	Saving rate of unskilled-workers household
G	Aggregate government expenditures	te_i^{EU}	Export subsidy for goods i sold in euros
i^G	Interest rate on loans to government	te_i^{US}	Export subsidy for goods i sold in dollars
i^P	Interest rate on loans to private sector	tm_i^{EU}	Import tariff for goods i bought in euros
$K_{i,-1}$	Capital stock (net of deprec.) in sector i	tm_i^{US}	Import tariff for goods i bought in dollars
L_G^S	Skilled labor employed in public sector	ts_i	Sales tax of goods i
L_G^U	Unskilled labor employed in public sector	ty^K	Income tax on capitalist household
L^S	Labor force of skilled workers	ty^S	Income tax on skilled-workers household
L^U	Labor force of unskilled workers	ty^U	Income tax on unskilled-worker household
pwe_i^{EU}	Export price of goods i in euro trade area	UB	Unemployment benefit per unemployed
pwe_i^{US}	Export price of good i in dollar trade area	W_G^S	Wage rate for skilled labor in public sector
pwm_i^{EU}	Import price of goods i in euro trade area	W_G^U	Wage rate for unskilled labor in pub. sector
pwm_i^{US}	Import price of good i in dollar trade area	W_i^U	Wage rate for unskilled workers in sector i

Parameters

a_{ij}	Input-output coefficient	β_i^V	Value-added function share parameter
a_i^C	Composite-input function shift parameter	c_i	Share of aggregate consumption in sector i
a_i^E	Export function shift parameter	$?_i$	(Leontief) production function parameter
a_i^M	Import function shift parameter	g_i	Share of government spending in sector i
a_i^Q	Armington fuction shift parameter	F_i	Capital accumulation parameter
a_i^T	Transformation function shift parameter	$?_i^C$	Elasticity parameter for composite-input
a_i^V	Value-added function shift parameter	$?_i^E$	Elasticity parameter for exports
β_i^C	Composite-input function share parameter	$?_i^M$	Elasticity parameter for imports
β_i^E	Export function share parameter	$?_i^Q$	Elasticity parameter for Armington
β_i^M	Import function share parameter	$?_i^T$	Elasticity parameter for transformation
β_i^Q	Armington fuction share parameter	$?_i^V$	Elasticity parameter for value-added
β_i^T	Transformation function share parameter	z_i	Share of aggregate investment in sector i

REFERENCES

Devarajan, Shantayanan, Delfin S. Go, Jeffrey D. Lewis, Sherman Robinson, and Pekka Sinko, (1997) "Simple General Equilibrium Modeling," in *Applied Methods for Trade Policy Analysis* (Joseph F. Francois and Kenneth A. Reinhert, Eds.), Cambridge University Press, Cambridge.

Devarajan, Shantayanan, Jeffrey D. Lewis, Sherman Robinson, (1994) "Getting the Model Right: the General Equilibrium Approach to Adjustment Policy," *mimeo*, World Bank, Washington, DC.

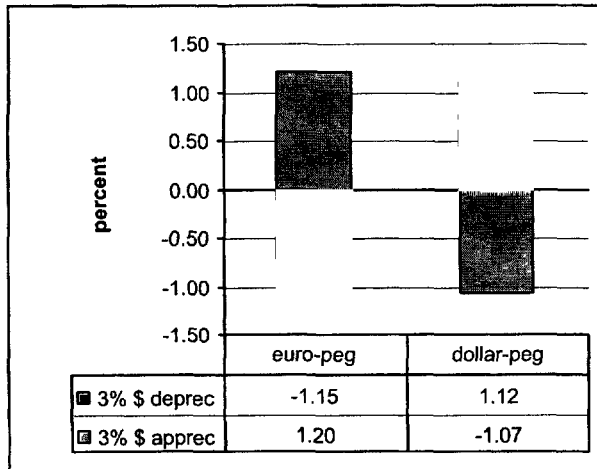
Fargeix, André, and Elizabeth Sadoulet (1994) "A Financial Computable General Equilibrium Program for the Analysis of Stabilization Programs," in *Applied General Equilibrium and Economic Development: Present Achievements and Future Trends* (Jean mercenier and T. N. Srinivasan, Eds.), University of Michigan Press, Ann Arbor, Michigan.

Robinson, Sherman, Antonio Yunez-Naude, Raul Hinojosa-Ojeda, Jeffrey D. Lewis, Shanayanan Devarajan, (1999) "From Stylized to Applied Models: Building Multisector CGE Models for Policy Analysis, *North American Journal of Economics and Finance*, Vol. 10.

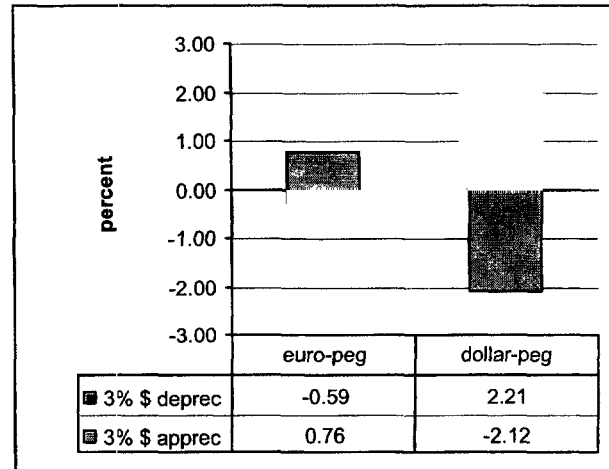
Tesche, Jean (1995) "Alternate Adjustments to External Shocks," *Journal of Policy Modeling*, 17(6): 615-637.

Figure 4. Main Economic Indicators (3% change of dollar-euro exchange-rate)

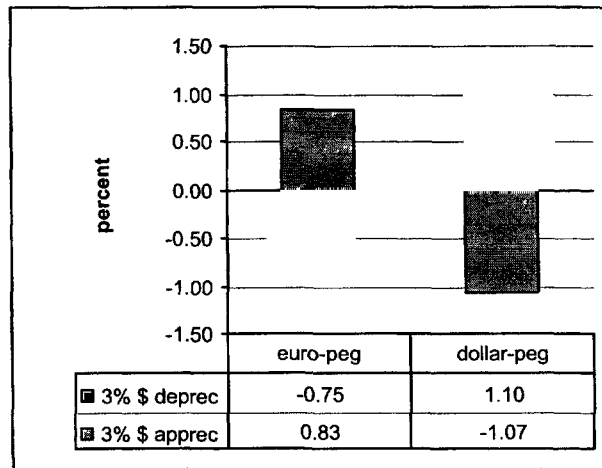
Percent Change in CPI



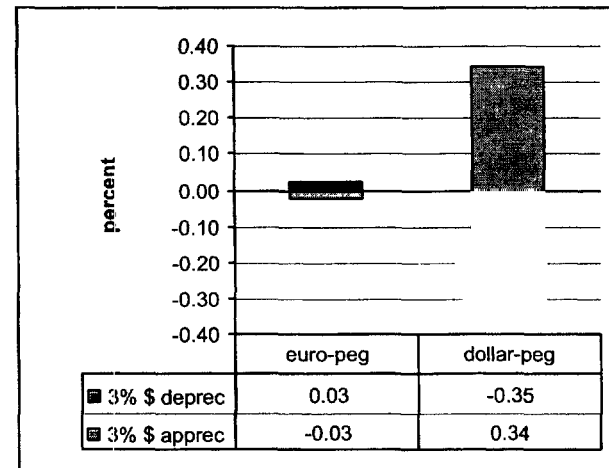
Percent Change in GDP



Percentage Point Change in Fiscal Deficit



Percentage Point Change in Trade Deficit



Percentage Point Change in Unemployment Rate

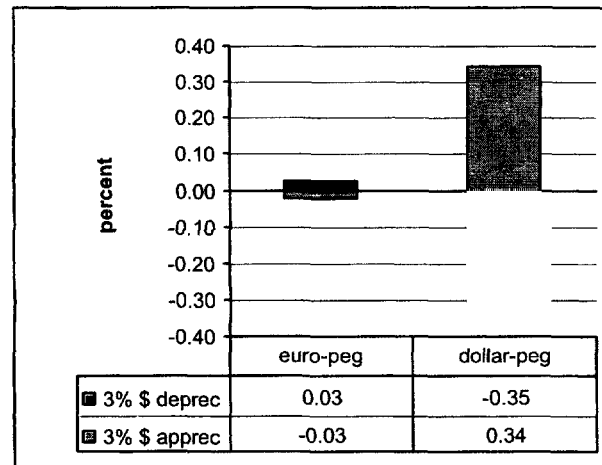


Figure 5. Effect on Exports (of 3% change of dollar-euro exchange-rate)

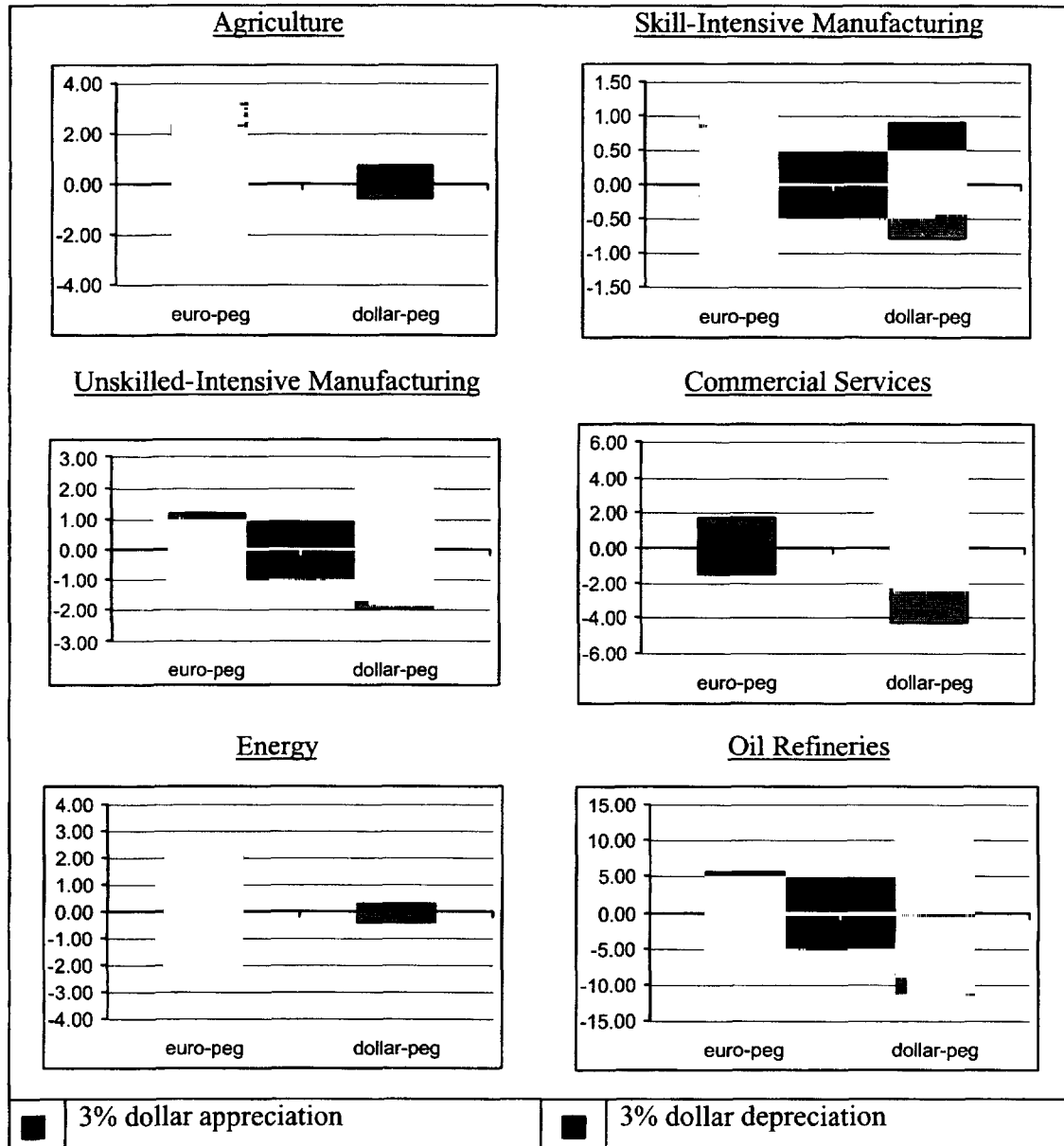
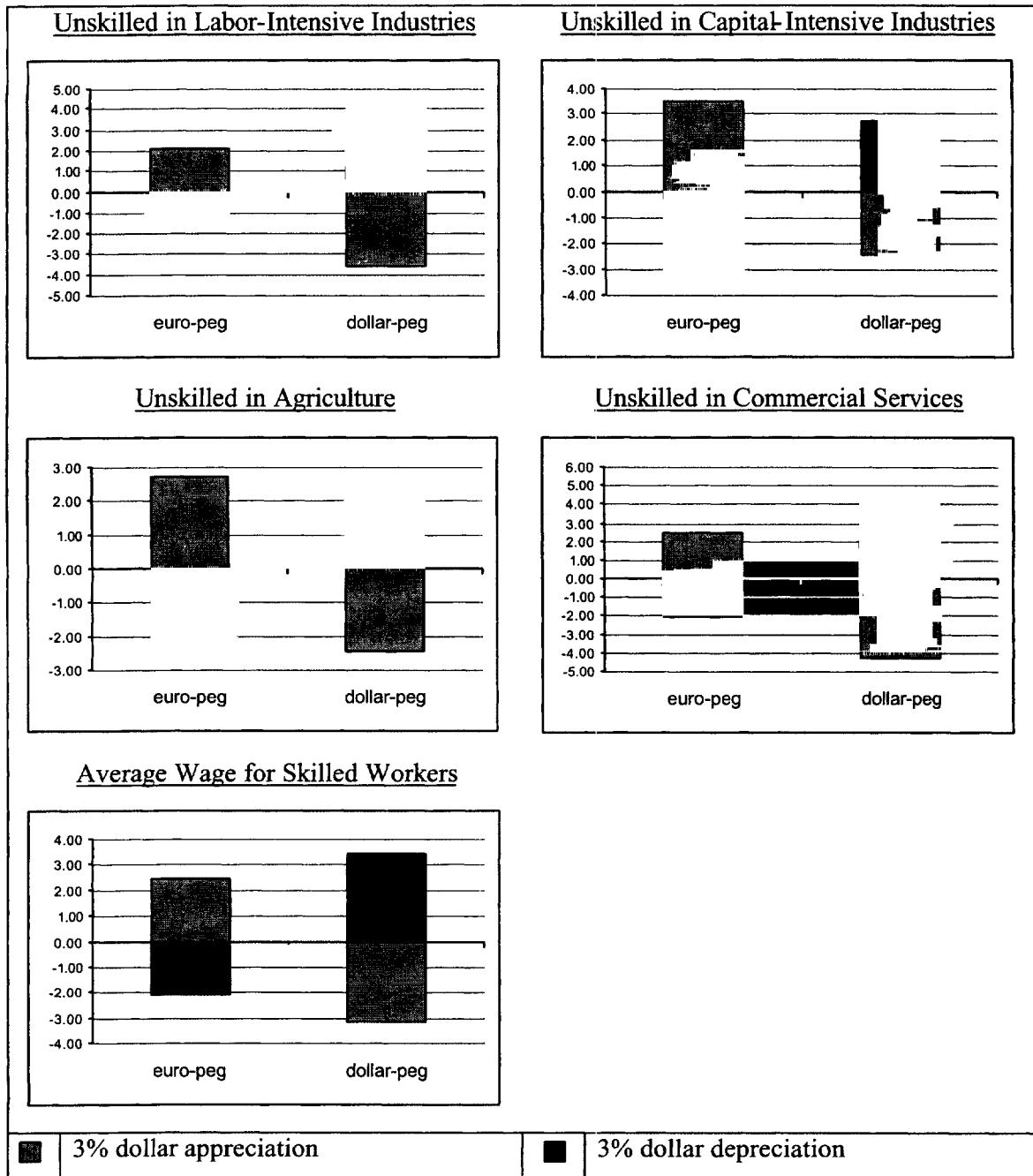


Figure 6. Effect on Employment (of 3% change of dollar-euro exchange-rate)



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